From the Ground Up

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Hardsetting of Soils

What exactly is hardsetting? It is a soil condition that occurs at the soil surface. The soil aggregates are so unstable that wetting causes the aggregates to breakdown and clay movement within the wet soil. Upon drying of these soils, the dried surface becomes compact and hard.
Exchangeable magnesium as well as sodium can increase this condition. The picture to the right shows a hardsetting soil. Often times you will also observe a layering of the soil below the compact surface.

Conditions that favor hardsetting is low organic matter content and a soil texture such as loamy sands, sandy loams, sandy clay loams, and sandy clays.

Gypsum is a cure for hardsetting because it will increase the electrolyte content of the soil and reduce the exchangeable sodium and magnesium. It is best to keep the gypsum shallow, in the top 1 or 2 inches to reduce this condition.

Solubility of Gypsum

Gypsum (calcium sulfate dihydrate) is considered to be about 200 times more water soluble than calcitic limestone, but its solubility is lower than fertilizers such as potassium chloride or ammonium sulfate. These fertilizers are considered 200 times more water soluble than gypsum.

From a practical standpoint what does this mean? It means that the availability of calcium from gypsum is much greater than the availability from calcitic limestone. The calcium sulfate will move more readily than limestone so it can be surface applied and will move through the soil profile. Purdue University research has shown that after two years increases in water soluble calcium were detected down to 3 feet. It means that the sulfur from gypsum will not leach as quickly from the soil profile as that from

ammonium sulfate. At the rates of calcium sulfate that we are applying (1/2 ton-3 tons) there is adequate available sulfur to meet the plant's needs during the year of application and several years thereafter. The benefits of gypsum can be realized for many years after the initial application and in fact are often reported to be better the second and third years.

When applying gypsum to sodic or alkali soils the solubility is increased however by about four fold (Abrol et al., 1979 and Oster and Frenkel, 1980). This is because there is a preference of the exchange sites for divalent calcium cations compared to monovalent sodium ions. The higher the degree of sodium saturation the greater will be the dissolution of gypsum. This is apparent when viewing soils where gypsum has been applied. In those alkali spots the gypsum seems to disappear very quickly (within a few months), but outside of the alkali spots gypsum crystals can be observed for a much longer time.

Gypsum improves Infiltration and Hydraulic Conductivity

As the pictures to the left show, most of the time there is much less standing water in the field after a rain event where the gypsum is applied. The top picture was the area of the field that received 1 ton/A of PRO CAL 40 this spring. The bottom picture is from the same field about 100 yards away where the PRO CAL 40 was not applied. This is a Missouri river bottom soil with a high magnesium level.

The hydrated radius of the Magnesium ion is approximately 50% greater than that of the calcium ion. This means that more water is attracted to the soil particles when more exchangeable magnesium is present.

This will weaken the forces that keep soil particles together. It will also tend to increase clay swelling and dispersion of the clays. The overall effect is decreased aggregate stability, reduced infiltration rate and hydraulic conductivity. This means that the water does not enter the soil as rapidly and will not move down through the soil at as fast of rate. If water does not move into and through the soil it will run off and increase soil erosion. If the water runs off the field, less water will be stored in the soil for plant use. Gypsum sources such as PRO CAL 40 increases the exchangeable calcium level plus increases the electrolyte level. Both of these factors reduce the swelling of the clays, improve aggregation and allows for greater water efficiency.

Irrigating Soybeans

Most producers have a pretty good handle on irrigating corn, however, irrigating soybeans is more controversial. Here are some points to ponder.

- Most research and producer experience has shown that irrigation prior to beginning pod development (R3) is of little value or may actually decrease yield. The exception to this may be in very sandy soils or where soil profiles have been depleted from previous cropping and was not replenished. Earlier irrigation may be necessary to just keep plants alive or to be able to keep up during the high use stages of reproduction.

- Soybeans need 6-8" of moisture up to the beginning bloom stage (R1)

- Between the R1 stage (beginning bloom) and the R6 stage (full seed), about a 28 day period, soybeans need 12 to 14" of water.

- After the R6 stage (full pod), soybeans still use 2" of water.

- Peak water usage for soybeans is during R2 (Full Bloom) and R3 (beginning pod) stages when daily requirements are 0.3 inch per day.

- For every bushel of soybeans, approximately 13,500 gallons of water is required. For every bushel of corn approximately 5,000 gallons is required.

- If water for irrigation is limited, giving adequate moisture at pod fill can achieve 90% of maximum yield.

Things to remember when Foliar Feeding Crops

Below are some points to remember when considering foliar applications on your crops. Most of these have been offered to us from experienced producers.

- Soil Test First; know your limitations.
- Have your soil in balance first. Calcium levels should be at least 65% base saturation and Ca/Mg ratios of 5/1.
- Identify yield limiting factors that may reduce foliar feeding effectiveness.
- If temperature + humidity > 140 do not foliar feed crop. (ie. temp. = 85 and humidity is 60%)

- Use high pressure, small droplets
- If heavy dew is present, reduce the amount of water.
- Using ground application equipment, apply 8 gal/a.
- Using aerial application use 2-3 gal/a.
- Add 1/2 lb. of sugar per acre to enhance response.
- Citric acid used in with foliar fertilizer has enhanced response in corn.
- When foliar feeding use a complete fertilizer with all micronutrients.
- In general, foliar responses to phosphorus and potassium are more prevalent with earlier foliar applications. Crops in the mid and late stages of development respond more to foliar applied nitrogen.